To Quit or Not to Quit: An Economic Analysis of Smoking Cessation Decisions

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I. INTRODUCTION

Smoking is the leading preventable cause of death in the U.S., contributing to more than 400,000 deaths annually. A recent public health initiative, *Healthy People 2010*, aims to cut the prevalence of smoking among adults in half, from the current rate of about 24 percent to 12 percent. While recent policy debates have tended to focus on how to prevent youth from starting to smoke, a recent analysis concludes that the *Healthy People 2010* objective cannot be met without large increases in smoking cessation rates (Mendez and Warner 2000). Moreover, encouraging and helping current smokers to quit is a very promising route to improve public health. As one of the required cigarette warning labels reads: "Quitting smoking now greatly reduces serious risks to your health." Research indicates that within five to 15 years of quitting there are large and statistically significant reductions in heart disease, stroke and lung cancer (USDHHS 1990). Despite these clear gains to quitting, the rate of quitting in the U.S. appears to be stalled. Hughes et al. (1999) reports that the percentage of ever-smokers who have become ex-smokers in the U.S. increased steadily from 1960-1990. But this increase did not continue from 1990-1995, despite increases in cigarette excise taxes and the introduction of new smoking cessation products. This trend is especially troubling in light of the recent increase in the number of young smokers who will soon become or have become adult smokers.

In this paper we explore smoking cessation decisions among a cohort of young women who began smoking in the 1960s, about the time the U.S. began to step up its anti-smoking campaign. We use retrospective smoking histories from a large nationally representative panel data set, the Young Women Cohort of the Original Cohort Databases of the National Longitudinal Study (hereafter NLS Young Women). The core data consist of a panel of young women who were first surveyed in 1968 and subsequently re-surveyed every other year until

1997. The period from 1968 to 1997 witnessed a variety of anti-smoking measures, including increases in the federal and many states' cigarette excise taxes, new Surgeon General's reports on the health consequences of smoking and the benefits of quitting, new cigarette warning labels, and the introduction of new pharmaceutical products that help smokers quit. By appending information on cigarette prices and taxes by state, as well as other policy measures, we will be able to estimate discrete time hazard models that include many key determinants of quitting decisions. In addition to the policy measures, the strengths of the data include: repeated observations of the same individual; data on each person's full smoking history that allow us to separately distinguish the role of age and duration of habit in determining quit rates; a rich set of life-cycle events and other socioeconomic variables such as marital breakup, pregnancy, and family structure; and the ability to control for omitted factors which might otherwise lead to biased estimates of the effects of key policies. In the preliminary analysis reported below, we focus on the role of prices, smoking duration, pregnancy, and a limited number of socioeconomic factors.

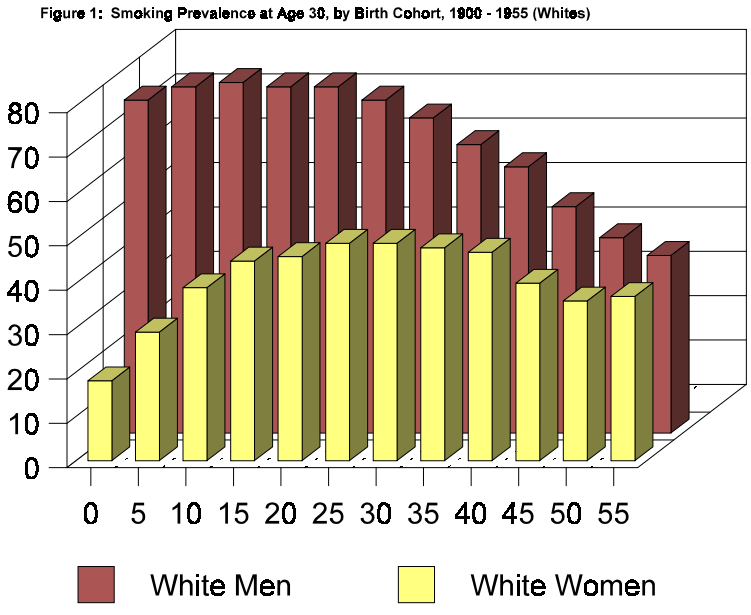
Section II discusses the importance of understanding the determinants of women's smoking decisions. Section III briefly reviews previous economic research on cigarette prices and smoking behavior. Section IV discusses the measurement of smoking cessation, paying particular attention to the use of retrospective smoking histories. Section V reviews the data and empirical approach, while Section VI presents the preliminary results.

II. WOMEN'S SMOKING DECISIONS

In addition to health risks common to both women and men – such as heart disease, chronic obstructive pulmonary disease, and lung cancer – women face additional risks related to fertility and child-bearing. Smoking during pregnancy is associated with complications

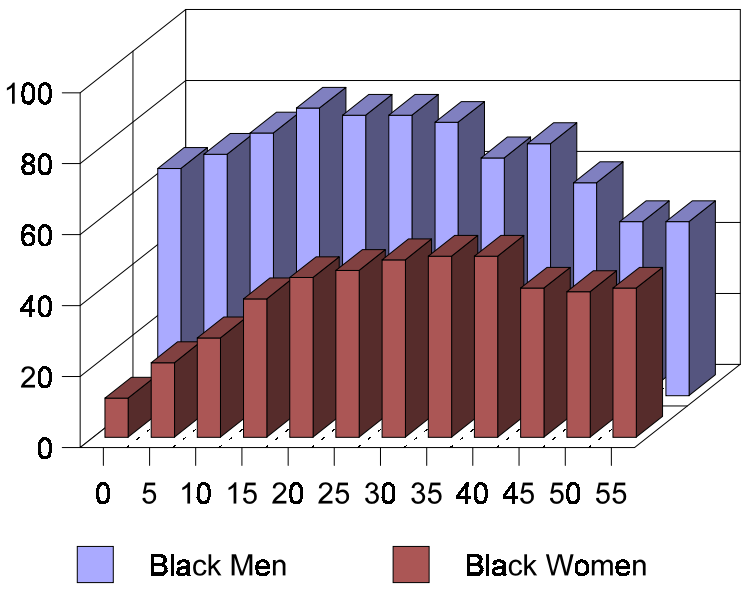
including spontaneous abortion, lower birth weight infants, and higher risks of perinatal mortality and sudden infant death. In addition, because women are more involved in child care than are men, women's smoking may create more risks related to childhood exposure to secondhand smoke. The U.S. EPA's (1992) report on secondhand smoke concludes that secondhand smoke increases the number and severity of episodes of childhood asthma, and is a risk factor for new cases of asthma in children who have not previously displayed symptoms. Somewhat less directly, women's smoking decisions may even be important influences on their children's decisions to initiate smoking. As an example of parent's potential influence, Hersch (1998) reports that smoking rates are much lower among both white and nonwhite youth who live in households where smoking is not permitted. Given these special concerns, it is perhaps not surprising that the 2001 Report of the U.S. Surgeon General focuses entirely on women and smoking (USDHSS 2001). The 2001 Report is just the latest example of Reports and other public information campaigns including required cigarette warning labels that emphasize the special risks of women's smoking.

The trends in women's smoking over time also deserve special attention. The prevalence of current smoking among women is almost as high as among men: 22 percent among women versus 26 percent among men (USDHSS 2001). However, to paraphrase a cigarette advertising campaign, women have come a long way to achieve this (unhealthy) equality. Figures 1 and 2 show current smoking prevalence at age 30



among different cohorts of white and Black women and men (Burns *et al.* 1997). In the cohort born between 1900 and 1904, only 18 percent of white women smoked at age 30, compared to 75 percent of white men. While smoking was less common among Blacks in the 1900 - 1904 birth cohort, the gender gap was similar: only 11 percent of Black women smoked at age 30, compared to 66 percent of Black men. Smoking rates steadily climbed for later birth cohorts of women until about 1940, while there was less of an increase and then a faster decrease in smoking rates among later cohorts of men. In the birth cohort born between 1955 and 1959 (which is slightly younger than the cohort represented in the NLS Young Women), the gender gap had narrowed so that smoking was nearly as prevalent among white women (37 percent) as among white men (40 percent), with somewhat more of a gap in the smoking prevalence of Black women (42 percent) and Black men (49 percent).

Figure 2: Smoking Prevalence at Age 30, By Birth Cohort, 1900 - 1955 (Blacks)



There is even more gender equality in smoking prevalence in more recent birth cohorts. The Monitoring the Future (MTF) data suggest that the prevalence of current smoking was higher among high school senior girls than boys in the late 1970s and early 1980s (USDHSS 2001). Since the mid 1980s, smoking prevalence among high school senior girls and boys has been roughly comparable. In 1998, the MTF estimate of the prevalence of current smoking

among high school senior girls (33.4 percent) was not statistically significantly different than the estimated prevalence among high school senior boys (36.2 percent).

III. CIGARETTE PRICES AND SMOKING BEHAVIOR

Empirical studies provide evidence that adults decisions about cigarette consumption obey the economic "law of demand:" when prices of cigarettes go up, the amount consumed falls. Cigarette demand functions have been estimated using different types of data and measures of consumption: time series data on national aggregate consumption; pooled time series of state cross-sections; and micro-level data on consumption from surveys of individuals. As reviewed by Manning *et al*. (1991, Appendix A) estimates of the price elasticity of cigarette demand range from -0.22 to -1.0. Based on their expert evaluation of the reliability of the different available estimates, the consensus of a National Cancer Institute sponsored group put the price elasticity in a narrower range, from -0.3 to -0.5 (National Cancer Institute 1993a). It is important to note that these studies do not examine quitting behavior. The response to price or tax increases reflects changes in starting behavior, changes in quantity consumed, and changes in quitting behavior.

Micro data on individual smoking behavior appear to offer the potential to sort out the extent to which higher prices discourage starting, encourage current smokers to cut down, or encourage current smokers to quit. A standard specification uses cross-sectional data on individuals' smoking behavior to estimate a two part model, where the first part is a model of smoking participation, and the second part is consumption conditional upon participation (e.g., Wasserman et al. 1991, Evans, Farrelly and Montgomery 1999). A typical finding is that about half of the response to price is due to changes in smoking participation, and the other half is due to changes in consumption among current smokers. However, Moore (2001) points out a

fundamental flaw with the standard specification: never smokers and former smokers are lumped together into a single, non-smoking group. This mis-specification can lead to serious errors in inference. For example, Evans, Farrelly and Montgomery (1999) claim to find strong evidence that worksite smoking bans reduce smoking prevalence. Moore's re-analysis of the same data suggests that there is a strong positive relationship between worksite smoking bans and never smoking or having quit long before the worksite ban was in place. Moore (2001) suggests his results "strongly support the hypothesis that the observed association between smoking status and workplace smoking bans is more a reflection of the underlying preferences of employers and workers than of any direct causal process."

There are not many studies that distinguish between starting and quitting behavior in examining the price-responsiveness of consumers. Hamilton et al. (1997) assess the effect of the tobacco tax cuts made in 1994 on the smoking habits of Canadians and conclude that smoking quit rates were lower in provinces where tobacco taxes had been cut compared with those provinces that did not cut taxes. Douglas and Harihan (1994) and DeCicca ,Kenkel and Mathios (1999) examine starting behavior and both of these studies find that prices have little effect on the probability of starting to smoke. Douglas (1998) expands his earlier work and estimates the hazard rate of quitting and starting to smoke. The author concludes that quitting hazards are more sensitive to cigarette prices, regulation and health information. There is, however, an important limitation to this paper. The author uses the 1987 National Health Interview Survey and uses retrospective data on when the respondent started to smoke. These data are then matched to the state that the respondent lives in during the interview so that taxes and other state regulatory variables can be linked with smoking behavior. However, this state assignment is a significant if not fatal weakness in the design of this study since any individual who has moved

will be assigned the 'wrong' state for some of their smoking duration. Our proposed study will solve this problem by using an alternative data and study design so that we can assess the state of residence in each year of their smoking history.

There are a number of studies that focus on how quitting behavior varies with the frequency and intensity of prior smoking. The results of these studies provides a mixed picture of this relationship. Some research indicates that the smoking history is an important predictor of who will be a successful quitter. Khuder, Dayal and Mutgi (1999) find that age of initiation was a significant factor in explaining who does not quit smoking. Osler et al. (1999) finds that the prevalence of quitting was negatively correlated with the amount of tobacco smoked. Hughes et al. (1999) finds, however, that reductions in smoking activity does not predict smoking cessation in the future. Sargent, Mott and Stevens (1998) finds that the cessation rate of adolescent smokers who have low levels of frequency use are more likely than daily users to quit. In a study

comparing hand-rolled cigarettes and manufactured cigarettes, Kraft, Svendsen and Haukness (1998) find that nicotine dependence was higher among smokers smoking hand-rolled cigarettes and were less motivated to quit. Gilpin, Cavin and Pierce (1997) find that occasional smokers differed from daily smokers with respect to long-term quitting behavior, plans to quit and confidence that they could quit. Pierce, Farcas and Gilpin (1998) find that heavy smokers who have an intention to quit and a limited quitting history are predicted to show some movement toward quitting.

IV. RETROSPECTIVE SMOKING HISTORIES

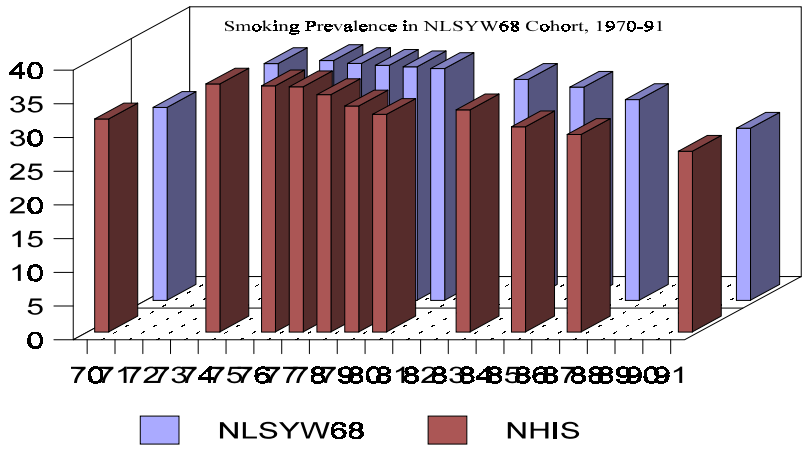
The analysis reported below uses retrospective self-reported data to constructive lifetime smoking histories for the respondents of the NLS Young Women survey. An obvious concern is

the usefulness of such data. While smokers report less than their true consumption (Warner 1978), they fairly accurately report *whether* they currently smoke (smoking status). In a meta-analysis of studies that compared contemporaneous self-reported smoking with biochemical markers of smoking, Patrick *et al.* (1994) find that smoking status indicators based on self-reported information had an average sensitivity of 87.5 percent and an average specificity of 89.2 percent. Sensitivity and specificity measure respectively the proportion of smokers and nonsmokers correctly assigned their respective labels. Machlin, Kleinman, and Madans (1989) find, using retrospective and contemporaneous data from the National Health and Nutrition Examination Studies, that contemporaneous and retrospective measures of (baseline) smoking status agreed for more than 90 percent of the sample. Because we construct smoking histories using similar methods to Machlin, Kleinman, and Madans, their results suggest that retrospective information on smoking will be useful.

To further explore the usefulness of retrospective information on smoking, we next investigate whether retrospective reports on smoking behavior generate rates of smoking prevalence in a given year that match contemporaneously measured rates of smoking prevalence from another data set for that cohort and year. We compare data from the NLS Young Women to data from various years of the nationally representative National Health Interview Survey (NHIS). The NLS Young Women is the primary source of data for our econometric analysis and is described in more detail below in Section V. One of the original NLS cohorts, the NLS Young Women consists of a cohort of 5,159 young women who were between the ages of 14 and 24 as of January 1, 1968. In the 1991 wave of the NLSYW68, respondents were asked at what age they first smoked regularly and former smokers were asked the age they last smoked regularly. We use these data and the respondent's age to compute the calendar year a woman

started or quit smoking. For example, if a respondent reported that she stopped smoking regularly when she was 30 years of age and she was 20 years of age in the 1968 original survey, we know that she quit in 1978. In this exercise, we assume a person smoked in each intervening year between her computed start and quit years. We then estimate smoking prevalence rates from 1970 to 1991. We use sample weights to derive estimates that are nationally representative of the population of women in this age cohort in 1968.

Figure 3 compares the estimates of smoking prevalence from the NLS Young Women to the NHIS estimates of contemporaneous smoking prevalence, in each year shown, of women of exactly the same age as the NLSYW68 cohort. As can be seen, the NLS Young Women retrospective estimates and the NHIS contemporaneous estimates of smoking prevalence are strikingly similar. In most years, the estimated prevalence rates are within one or two percentage points of each other. The trends in smoking prevalence rates based on retrospective and contemporaneous reports are also very similar. Both sets of estimates suggest that, in this cohort of women, smoking prevalence rates hover near 35 percent from 1974 to 1978, after which they begin to fall, reaching about 26 percent in 1991.

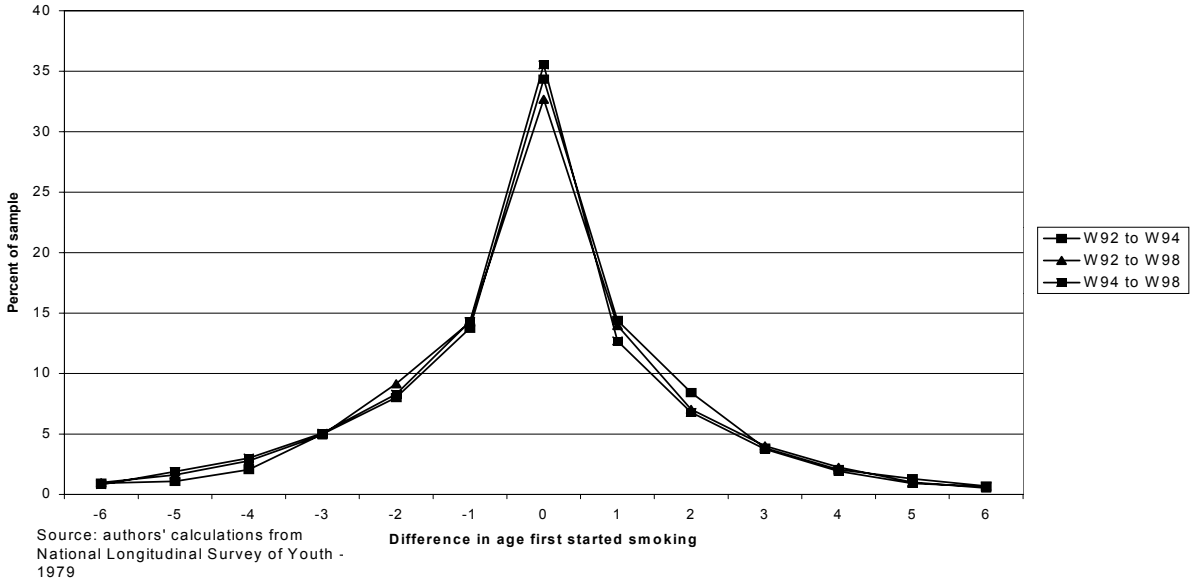


To further explore the usefulness of retrospective information, we use data from the National Longitudinal Survey of Youth - 1979 (NLSY79) to investigate the concordance

between retrospective information on start and quit dates and contemporaneously measured smoking status. In 1984, the NLSY79 asked respondents about current smoking status. From retrospective smoking questions asked in 1992, 1994 and 1998, we construct indicators of whether a person smoked in 1984. We then compare the contemporaneous 1984 smoking status variable with our 1992, 1994 and 1998 status variables based on retrospective information. Using the sample of respondents interviewed in both 1984 and 1992, retrospective information from 1992 would classify, as smokers, 77 percent of those who reported smoking when asked in 1984. Retrospective information would classify as smokers 13 percent of those who, in 1984, reported they did not smoke. The extent of agreement between the contemporaneous measures and measures based on retrospective reports in 1994 and 1998 is very similar. These results suggest that measures of smoking status based on retrospective information are reasonably sensitive and specific (judged by contemporaneous reports of smoking status).

We also examined the set of mis-classification errors for patterns. Preliminary analysis showed that respondents who reported in 1984 that they smoke only a few cigarettes a day were much more likely to report retrospectively in the 1990s that they did not smoke in 1984.

Figure 1. Distribution of Differences in Age of Smoking Onset
NLS79 1992, 1994, 1998



Source: authors' calculations from National Longitudinal Survey of Youth - 1979

Finally, we explored whether retrospective information collected at different dates in the NLSY79 yielded similar information. Figure 1 illustrates the extent of agreement between the age of starting smoking as reported in 1992, 1994, and 1998. For about a third of the relevant sample there was perfect agreement between the retrospective reports in 1992 and 1994. When the retrospective reports disagreed, it was usually by only a year or two: almost two-thirds of the

relevant sample reported start dates within plus or minus one year; and almost 80 percent of the relevant sample reported start dates within plus or minus two years. There was only slightly less agreement between retrospective reports in 1994 and 1998, and 1992 and 1994. The distributions shown in Figure 1 are roughly symmetric, with no strong pattern of systematically younger or older start ages in later surveys. Based on previous research and the exploratory analysis to date, although retrospective smoking histories undoubtedly contain some errors, the measures appear reasonably accurate.

V. DATA AND EMPIRICAL APPROACH

Data

The data used to estimate the determinants of quit behavior comes from the National Longitudinal Survey (NLS), sponsored by the Bureau of Labor Statistics. The NLS gathers information at multiple points on time on the same individuals. We utilize the Young Women cohort, which includes 5,159 young women between the ages of 14 and 24 as of January 1, 1968. The sample was originally selected to be nationally representative of the civilian, non-institutionalized population of women in the respective age group residing in the United States at the time the sample was drawn. Since 1968 these respondents were surveyed an additional 18 times the last being in 1997. The U.S Bureau of the Census conducted all of the surveys with interviewers administering 13 in person and 6 by telephone. As of the 1995 interview, 3,039 (58.5%) of the original sample still participate in the surveys. The data include sampling weights based on the original survey. These weights are adjusted after each subsequent interview in part to account for persons who were not interviewed. Analysis by Parnes (1992) suggests that the re-weighting scheme allows the samples to remain representative. Surveys include several types of data including core data on the individual, data on the respondent's

family and household composition as well as data, that for most respondents, allows the investigator to identify their state of residence.

The 1991 survey includes questions on the frequency of the respondent's current and past use of cigarettes. Questions asked the age when the respondent first smoked regularly, the age when she last smoked regularly, and the number of cigarettes usually smoked a day. The 1993 questionnaire included similar questions though they focused on current smokers and the number of cigarettes smoked per day. The 1995 and 1997 surveys inquired about whether the respondent currently smokes.

Based on the 1991 smoking questions we can construct a lifetime smoking history because each individual provides the age at which she started to smoke regularly and the age at which she stopped smoking regularly. Moreover, this information combined with the age of the respondent allows us to know for each calender year whether an individual was smoking or not. Consider a respondent who was 24 years of age when the survey began in 1968. If in the 1991 survey they report starting to smoke at age 14 we know that they were smoking in 1958. Consequently, the NLS data allow us to construct, for each respondent, whether an individual is smoking in a particular calender year beginning in the early 1950s through 1997.[1] Since almost no one begins smoking until the age of 9, conceptually we use 1953 as our initial year of analysis. While the use of the retrospective question allows us to construct smoking histories for years prior to 1968 (the year of the initial survey), all right hand side variables that are not based on retrospective questions are not available prior to 1968. Table 1 provides the number of NLS respondents who report smoking in each year. Given the age of the original respondents it is not

[1] The 1993, 1995 and 1997 data are not retrospective. If a respondent reports that they were smoking in 1993 and in 1995 they were assumed to be smoking in 1994 as well. Similarly, if they reported smoking in 1995 and 1997 they were assumed to be smoking in 1996.

surprising that only a few individuals smoked in the years 1953-1956. The oldest respondents in the original sample were only 9 years old in 1953 and thus very few of them are at the age when smoking typically begins. However, a number of women begin to smoke in 1958 and the number of smokers rapidly increases so that by 1971 (where the age range of women in the sample is 17 to 27 years of age) approximately 1,000 of these women are smoking. The number of smokers in each year is important because these are the potential sample of quitters that we will utilize to examine quitting behavior.

Based on the retrospective smoking data and the respondents age, we can compute the calender year in which each respondent quit. We utilize the retrospective data for computing quit year for the years 1953-1991. For example, if a respondent reports that they stopped smoking regularly when they were 25 years of age and they were 20 years of age in the 1968 original survey we know that they quit in 1973. After 1991, we observe the smoking status of the respondent in 1993, 1995, and 1997. These data allow us to compute quit rates for the years 1992-1997.[2]

Table 1 provides the number of individuals that quit in each year ranging from 1953-1997. The data show that while many individuals begin to smoke in the 1960s, there are very few quitters. Quitting behavior starts to increase as the number of respondents who smoke increase (a necessary condition for quitting) and as the 1968 original survey respondents are in their 20's and 30's and 40's.

The data in Table 1 (the number of smokers in each year along with the number of smokers who quit during that particular year) provide the basis for computation of the quit

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[2] Since the smoking data after 1991 is no longer retrospective and only observed every two years we will divide the quitters equally among the two intervening years and check the sensitivity of the analysis to this assumption.

hazard rate – that is the probability of quitting given that someone is smoking at the particular time. In Table 1 the quit hazard rate is computed for each calender year ranging from 1953-1997. Quit hazard rates are very low until the mid to late 1960s and then increase quit dramatically so that by the late 1980s and early 1990s quit rates have risen to over 4 percent.

The Discrete Time Hazard Model

Discrete time hazard models are an especially attractive specification to use to explain individual variation in quitting behavior. In this approach the sample consists of each individual who is at risk of the event (quitting) at each point in time. The level of analysis is whether an individual quit during a particular year given that they were at risk of quitting (that they were a smoker). Each respondent contributes an observation to the sample every time they are at risk of quitting. Table 2 provides the number of smokers in each year. Since each smoker in each year is at risk of quitting, the number of observations is the sum of the number of smokers in the years 1953-1997. According to Table 2 this provides over 30,000 observations for analysis. If we restrict our analysis to the years 1968-1997 we still retain over 27,000 observations.

<u>The Regression Model</u>

The discrete time hazard model is used to explain the quit rates of individuals. The hazard model described by equation (1) can be thought of as a demand to quit smoking function for an addictive good during any stage of the addiction. Equation (1) will first be specified for the sample of NLS respondents who indicate that they have never moved. These data allow for the most reliable linkages between respondents and state of residence (which is our key link for some of our policy variables) and thus serves as our starting point for our analysis. The three subscripts on the variables in equation (1) represent the three major sources of variation used in

this study. The subscript i represents the particular respondent, the subscript j represents the state in which the respondent resides, and the subscript t represents the current year in which the smoker is at risk of quitting. For example, for a respondent who smokes from 1968 - 1972 and then quits will be in the data set four times with t equal to 1968 for their first observation, 1969 for the second observation, etc. Some of the independent variables only vary by some of these factors. For example, the price variables are the same for all individuals residing in a particular state so that these variables have a j and t subscript only. Variables that are italicized indicate that they are a vector.

$$(1) \quad QUIT_{ijt} = \alpha_o + \alpha_1 YEAR_{ij} + \alpha_2 AGE_{ijt} + \alpha_3 CIGARETTE\ PRICE_{jt} + \alpha_4 YEARS\ SMOKED_{it} + \alpha_5 BIRTH_{ijt} + \alpha_6 DEMOGRAPHIC\ CHARACTERISTICS_{ij} + \alpha_7 STATE\ OF\ RESIDENCE\ (\text{Fixed Effects}) + \varepsilon_i$$

Below we describe the dependent and independent variables used in the analysis.

The Dependent Variable

The dependent variable is a 0-1 variable indicating whether the individual stopped smoking in a particular year conditional on them being at risk of stopping. Formally, the dependent variable is defined as follows:

$QUIT_{ijt}$ = 1 if respondent i living in state j is smoking in year t and not smoking in year t+1
= 0 if smoking in year t and smoking in year t+1.

Independent Variables

The independent variables include a number of factors that are likely to influence quitting behavior and are shown on the right hand side of equation (1). The right-hand side of equation (1) includes measurable influences that are likely to affect the probability that a individual will quit smoking during the next period. The right-hand-side variables include the cigarette tax rate,

the student's state of residence, warning label regulations, two vectors of different types of control variables, and measures of dropout status. Each of these are described below.

Age and Time Factors

There are a number of important factors that are likely to influence the probability of quitting. Quitting behavior is rare for young smokers and increases with adult smokers. Thus, age of the respondent in each year is a key independent variable to be included in the model. Since sample members reach the same age in different calender years the model can include both age and cohort effects so that cultural changes in attitudes toward smoking and advances in quitting technologies can influence the probability of quitting independently of a sample members age. The ability to model cohort effects is somewhat limited because there is only a 10 year range in ages in the original sample. Consequently, we include a year effect to allow the quit rate (controlling for age) to vary over time.

AGE_{ijt} = linear and quadratic (age of respondent i residing in state j at time t)

$YEAR_{ij}$ = the year the respondent i residing in state j is in the sample.

State Cigarette Prices

We are able to link NLS respondents to the states in which they reside for each of the years they are at risk of quitting smoking.[3] This allows us to examine the impact of state prices

[3] Though the NLS data does not include codes that directly link individuals to the state in which they reside this matching process can be done indirectly through the use of other variables available in the NLS. This is especially accurate for the original 1968 survey. For those respondents who indicate that they have never moved (a variable included in the NLS) we can use a matching algorithm that produces an accurate state assignment for their entire smoking history. The algorithm is based on information included in the older cohort sample. In this sample it is possible to identify the state of residence of each member in the older cohort. In addition to this information market level information that is associated with the locality of the respondent is provided such as the unemployment rate, size of local area labor force, index of demand for female labor. The identical market level information is provided for the young women cohort. Consequently, the market level variables can be matched to those in the older

(which include excise taxes) on quit behavior. Data on state cigarette taxes and prices for the years 1968 through 1997 are obtained from the Tobacco Institute's publication The Tax Burden on Tobacco. with the NLS data.[4] Table 2 illustrates the data for North Carolina, Massachusetts and California but these data are available for every state. The data indicate that there is a large amount of across state variation in taxes as well as within state variation in taxes. Moreover, these three states illustrate the rich variation in the different time paths of prices across states. We include the variable *Current Price* to examine the impact of contemporaneous taxes on the probability of quitting in that year.

CONTEMPORANEOUS CIGARETTE PRICE$_{jt}$ = the price of those residing in state j face in year t.

Past and Future Prices

The models incorporate rational addiction models of behavior (Stigler and Becker (1977) into the empirical framework Becker and Murphy (1988)) indicate that individuals obtain utility out of smoking cigarettes and that the amount of utility they obtain potentially depends on the history of consumption of these products. In myopic models of addictive behavior the past consumption of a good leads to current consumption of a good, but individuals ignore the future implications of this current consumption. Within rational addiction models, individuals anticipate that current consumption might change the marginal benefits of future consumption and make decisions with this information. These types of models indicate that both past and future consumption are likely to play a role in explaining contemporaneous quitting behavior.

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cohort who have identical values of these variables and the state value associated with these values can be assigned to the younger cohort.

[4] This is a standard source for tax and price data. The prices and taxes are adjusted for inflation.

The impact of future consumption versus past consumption on current quitting behavior helps distinguish between the myopic addiction and the rational addiction model. This distinction is important for policy because the rational addiction model suggests that consumers will see that price increases not only affect the cost of current consumption but of future consumption as well. There are several ways in which one can incorporate myopic and rational addiction into the empirical model. The most straightforward way is to examine whether quitting behavior not only depends on current prices but on past and future prices as well. As a result we include past, present and future prices as right hand side variables defined as:.

PAST CIGARETTE PRICE $_{j, t-1}$ = the cigarette price faced by those residing in state j in the year t-1.

FUTURE CIGARETTE PRICE$_{j, t+1}$ = the cigarette price faced by those residing in state j in the year t+1.

Smoking Duration

Equation (1) also includes a variable indicating how many years they have smoked prior to year t. This allows the hazard model to explicitly deal with duration dependence. In future models we will examine how the major policy variables, such as prices and warning labels differentially affect those who have been smoking for different lengths of time. In the current version of the model we include

YEARS SMOKED$_{it}$ = the number of years individual i residing in state j has been smoking prior to year t.

Pregnancy

Since pregnancy may change decisions about smoking we include the following variable.

TIME PREGNANT$_{ijt}$ = the proportion of the year respondent i, residing in state j is pregnant in year t.

Demographic and Other Characteristics

There are a number of demographic characteristics available in the NLS data. In this preliminary version of the model we focus on racial differences in quit behavior and whether the a respondent had a parent die due to an illness associated with smoking.

State of Residence (State Fixed Effects)

Equation (1) will be estimated with and without state fixed effects. The state fixed effects are included to capture the influence of unobserved differences across states in policies and anti-smoking sentiment. State fixed effects allow for a separate shift in the hazard rate for each state so that unobserved state heterogeneity is reflected in these intercept terms. These state fixed effects imply that the impact of prices on quitting behavior is estimated from only within state variation in prices. Since we observe individuals in a state over a period of 40 years there is a large amount of within state variation in the variables across time.

VI. RESULTS

Descriptive Statistics

The average hazard rate is .022 indicating that about 2 percent of the smokers in any year quit. The average age of the sample is 30.5. The minimum age in the sample is approximately 7 years old while the oldest is approximately 51 years of age(since the last survey includes data on the year 1998). The average real price of a pack of cigarettes in the sample is $1.56 with the minimum price equal to $0.98 and the maximum equal to $2.97. The average value of time pregnant is equal to 0.056 of a year.

Preliminary Regression Results

Tables 3, 4 and 5 provide different versions of the basic discrete time hazard model. Table 3 provides the basic model, Table 4 adds duration of smoking as a right hand side variable, and Table 5 adds both past and future prices as right hand side variables.

There are several results that are consistent across specifications. Blacks and American Indians are revealed to have significantly lower hazard rates of quitting compared with whites. This result is especially noteworthy because of recent evidence that the rate of smoking onset by young blacks is beginning to rise. These new smokers are more likely, according to our model, of becoming permanent adult smokers. This raises the importance of public health initiatives that lower the smoking onset of these groups.

Another key result is that women who are pregnant (measured as the percentage of the year that they are pregnant) have significantly higher quit rates than those who are not pregnant. There are significant public health implications from this result. The significant health consequences of smoking while pregnant are well documented. In future versions of this paper we will examine whether the warning labels directed at pregnant women changed the relationship between pregnancy status and quit rates.

In all three Tables, the coefficient on the time trend variable indicates that, independent of age, quit rates are increasing over time. This is an encouraging finding and in future models we will explore the shape of these time relationships and whether they can be explained by policy initiatives. For example, we will examine whether there was a shift in the time effect after workplace bans were introduced across states, after new warning labels were initiated, etc.

The results in Table 3 indicate that price does not have a significant impact on quit behavior. The coefficient is positive but insignificant. In Table 5 we include the past, current and future price in the specification. While this specification is consistent with a rational

addiction framework the correlation in current, past, and future prices is very high. The correlation between consecutive year prices are approximately .92, making identification difficult. The results in Table 5 indicate that while higher past prices are associated with higher quit rates, future prices increases are negatively associated with quit rates.

Finally, the results in Table 4 indicate that smoking duration lowers the probability of quitting. In future models we will examine the interaction of this duration variable with the other key factors in the model.

Table 1 - Number of NLS Respondents Who Are Smoking and Quit in a Calender Year										
Year	Real Price	Number of Smokers	Number of Quitters	Quit Rate		Year	Real Price	Number of Smokers	Number of Quitters	Quit Rate
1953		1	0	0.000		1976	1.45	1153	19	0.016
1954		1	0	0.000		1977	1.40	1142	25	0.022
1955		2	0	0.000		1978	1.47	1135	19	0.017
1956		5	1	0.200		1979	1.42	1130	19	0.017
1957	1.45	12	0	0.000		1980	1.33	1126	22	0.020
1958	1.38	21	0	0.000		1981	1.24	1109	27	0.024
1959	1.36	45	0	0.000		1982	1.23	1086	28	0.026
1960	1.41	80	0	0.000		1983	1.36	1074	18	0.017
1961	1.38	126	1	0.008		1984	1.49	1050	28	0.027
1962	1.41	177	2	0.011		1985	1.51	1036	23	0.022
1963	1.39	238	2	0.008		1986	1.56	1016	24	0.024
1964	1.42	302	4	0.013		1987	1.62	983	35	0.036
1965	1.41	407	1	0.002		1988	1.69	956	30	0.031
1966	1.48	517	3	0.006		1989	1.76	916	45	0.049
1967	1.49	627	10	0.016		1990	1.88	883	36	0.041
1968	1.57	734	6	0.008		1991	1.91	851	36	0.042
1969	1.56	835	12	0.014		1992	2.08	839	62	0.074
1970	1.62	918	13	0.014		1993	2.12	745	62	0.083
1971	1.61	999	9	0.009		1994		745	27	0.036
1972	1.69	1078	17	0.016		1995		697	27	0.039
1973	1.57	1109	21	0.019		1996		697	30	0.043
1974	1.53	1134	13	0.011		1997		update	update	
1975	1.48	1143	16	0.014		1998		update	update	

Table 2 - State and Federal Cigarette Excise Taxes Over Time in Selected States							
Year	North Carolina	Massa-chussetts	California	Year	North Carolina	Massa-chussetts	California
1954	$0.08	$0.13	$0.08	1976	$0.10	$0.29	$0.18
1955	$0.08	$0.13	$0.08	1977	$0.10	$0.29	$0.18
1956	$0.08	$0.13	$0.08	1978	$0.10	$0.29	$0.18
1957	$0.08	$0.13	$0.08	1979	$0.10	$0.29	$0.18
1958	$0.08	$0.14	$0.08	1980	$0.10	$0.29	$0.18
1959	$0.08	$0.14	$0.11	1981	$0.10	$0.29	$0.18
1960	$0.08	$0.14	$0.11	1982	$0.10	$0.29	$0.18
1961	$0.08	$0.14	$0.11	1983	$0.18	$0.42	$0.26
1962	$0.08	$0.14	$0.11	1984	$0.18	$0.42	$0.26
1963	$0.08	$0.14	$0.11	1985	$0.18	$0.42	$0.26
1964	$0.08	$0.14	$0.11	1986	$0.18	$0.42	$0.26
1965	$0.08	$0.16	$0.11	1987	$0.18	$0.42	$0.26
1966	$0.08	$0.18	$0.11	1988	$0.18	$0.42	$0.26
1967	$0.08	$0.18	$0.18	1989	$0.18	$0.42	$0.51
1968	$0.08	$0.18	$0.18	1990	$0.18	$0.42	$0.51
1969	$0.10	$0.20	$0.18	1991	$0.25	$0.46	$0.55
1970	$0.10	$0.20	$0.18	1992	$0.25	$0.46	$0.55
1971	$0.10	$0.24	$0.18	1993	$0.29	$0.75	$0.59
1972	$0.10	$0.24	$0.18	1994	$0.29	$0.75	$0.61
1973	$0.10	$0.24	$0.18	1995	$0.29	$0.75	$0.61
1974	$0.10	$0.24	$0.18	1996	$0.29	$1.00	$0.61
1975	$0.10	$0.29	$0.18	1997	$0.29	$1.00	$0.61
Source: The Tax Burden on Tobacco, Historical Compilation, Volume 32, 1997.							

Table 3 - Discrete Time Hazard Model of Quit Behavior				
	Without State Fixed Effects		With State Fixed Effects	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
Intercept	-55.0557	12.8618**	-57.4884	13.5844**
Age	-0.0311	0.0228	-0.0314	0.0246
Age Squared	0.00056	.00032*	0.00054	0.00035
Year Trend	0.0269	0.0067**	0.0282	0.0071**
Cigarette Price in Year t	0.1242	0.0837	0.1495	0.1095
Time Pregnant During Year t	0.3420	0.1103**	0.3502	0.1114**
American Indian	-0.1985	0.0702**	-0.2128	0.0732**
Black	-0.1880	0.0478**	-0.1728	0.0516**
Hispanic	-0.0527	0.1336	-0.0640	0.1391
Other Race	-0.0851	0.0533	-0.1179	0.0559**
Sample Size	24309		24309	
-2*Log-Likelihood	5133.865**		5082.199**	

Table 4 - Discrete Time Hazard Model of Quit Behavior With Duration				
	Without State Fixed Effects		With State Fixed Effects	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
Intercept	-55.5569	12.8633**	-58.1102	13.5907**
Age	-0.0257	0.0230	-0.0276	0.0248
Age Squared	0.00057	.00032*	0.00056	0.00035
Year Trend	0.0271	0.0067**	0.0284	0.0071**
Cigarette Price in Year t	0.1300	0.0838	0.1491	0.1095
Duration of Smoking	-0.0075	0.0039*	-0.0062	0.0040
Time Pregnant During Year t	0.3418	0.1103**	0.3502	0.1114**
American Indian	-0.1935	0.0703**	-0.2072	0.0733**
Black	-0.1915	0.0479**	-0.1752	0.0517**
Hispanic	-0.0653	0.1340	-0.0723	0.1392
Other Race	-0.0792	0.0534	-0.1120	0.0560**
Sample Size	24309		24309	
-2*Log-Likelihood	5130.388**		5079.944**	

Table 5 - Discrete Time Hazard Model of Quit Behavior with Past, Current and Future Prices				
	Without State Fixed Effects		With State Fixed Effects	
Variable	Coefficient	Standard Error	Coefficient	Standard Error
Intercept	-60.8151	12.9225**	-65.0645	13.7247**
Age	-0.0291	0.0228	-0.0328	0.0249
Age Squared	0.00054	.00032*	0.00058	0.00035*
Year Trend	0.0298	0.0067**	0.0321	0.0071**
Cigarette Price in Year t-1	0.5589	0.2219**	0.5738	0.2297**
Cigarette Price in Year t	0.2083	0.2786	0.2222	0.2820
Cigarette Price in Year t+1	-0.6682	0.1657**	-0.7067	0.1728**
Time Pregnant During Year t	0.3393	0.1103**	0.3494	0.1115**
American Indian	-0.2016	0.0705**	-0.2150	0.0735**
Black	-0.1949	0.0481**	-0.1763	0.0518**
Hispanic	-0.0461	0.1340	-0.0666	0.1394
Other Race	-0.0861	0.0535	-0.1206	0.0561**
Sample Size -2*Log-Likelihood	24309 5106.179**		24309 5052.610**	

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